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APPLE DISEASES.

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APPLE DISEASES.

BY DR. GEO. E. STONE.

The unusual interest now being shown in the renovating and planting of orchards has stimulated a desire on the part of the orchardist to know something of the different diseases affecting trees. For a long time before this the apple industry had been on the decline, and thousands of neglected apple trees could be found in the State bearing inferior fruit and affected with innumerable troubles foreign to well-cared-for orchards.

For years we have been observing different orchards, with particular reference to diseases and the results obtained from the systematic use of lime and sulphur and arsenate of lead. With the advent of the new interest in orcharding, and the consequent renovation of old trees and extensive pruning, spraying, cultivating and fertilizing, diseases have become much less prevalent.

A few years ago it was the practice to spray apple trees six or seven times a season, without much regard to whether it was necessary or not; but pruning and cultivation, etc., are fully as important as spraying, which should be done only with some definite object in mind. It is true that progress in the successful management of orchards has often been hindered by a too liberal practice of spraying at the sacrifice of other methods, and to-day many growers are obtaining good results with only two or three sprayings.

The experience and skill of intensive farmers have been of great aid in determining the cause of and methods for controlling certain diseases, and it has been demonstrated that many factors other than spraying help to produce healthy

crops. There are a number of fungous diseases occurring on the apple, some of which are parasitic; others follow mechanical injuries, and still others come about from various causes. The number of diseases affecting our cultivated crops is constantly increasing, most of them being introduced from other regions through commercial activities. Some apple diseases have been with us for many years, but just how long it is hard to learn in many cases, although some of the early works on fungi do not refer to them. The early agricultural and horticultural references are also very meager, and the identity of the disease is often left in doubt.

Some of the diseases affecting the apple in Massachusetts are given below.

Rots.

There are a number of fungi causing apple rots, and those found on the apple in this State are given below. In some sections of the country these rots cause an enormous amount of damage during the summer months, especially in warm, sultry, rainy weather. They are not serious here, usually being found on apples lying on the ground which have been bruised or are in an over-ripe condition, and also on those under poor storage conditions.

Bitter Rot (Glomorella rufomaculans (Berk.) Spandl. and von Sch.).

This rot (Fig. 1) has been known in this region for many years, and almost invariably attacks the apple on the ground or in storage, although some early varieties are occasionally affected to a slight extent on the tree, especially during warm, muggy weather. It is more serious in the west and south, where it causes an enormous amount of injury to apples.

The disease is characterized by dark-colored areas on the surface of the apple, which later contain minute, dark-colored pustules. These pustules contain smaller and more slender and light-colored spores than those of the *Sphæropsis* rot, described below. This as a rule constitutes only about 5 or 10 per cent of the apple rots in this section, although in

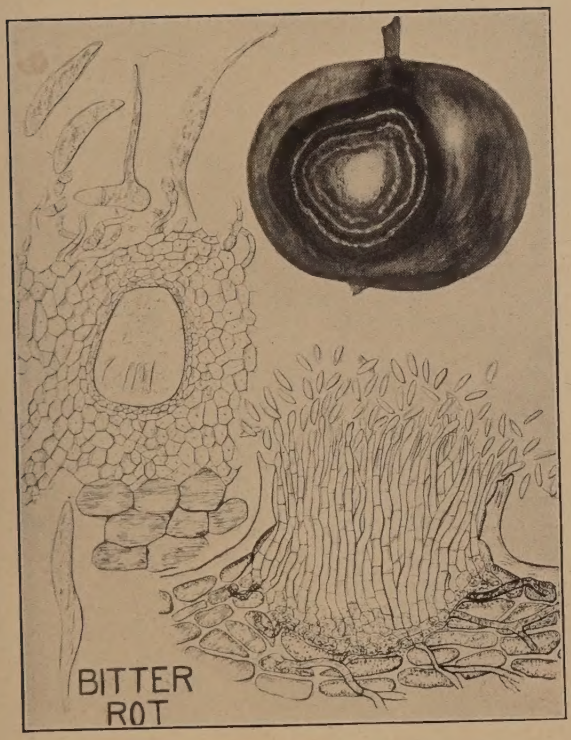

FIG. 1. — Bitter rot of apple.

1912 it was the most common of all. As already stated, it is much more serious in warm sections, and its unusual prevalence on fruit lying on the ground or in storage the past season was apparently due to the fact that the season was so warm.

According to our experience this rot hardly deserves treatment by spraying, since it makes its appearance so late and is confined to fruit that has been picked. Care should be taken to avoid all bruising in picking, and to secure the best possible storage conditions.

Black Rot (Sphæropsis Malorum Pk.).

This is usually the most common rot of apples in storage and on the ground, and we have never seen it attacking fruit on the tree in this State. It is quite similar to the preceding in appearance. The principal naked-eye characteristic distinguishing it from other rots is the absence of concentric growth of the fruiting bodies. The spores are borne in little pustules, resembling those of the bitter rot, but are larger and darker colored.

Sphæropsis is associated with one of our common cankers, and in all probability is responsible for most of our apple leaf spots. As an economic factor this rot is of little importance in this State and does not warrant spraying treatment.

Fruit Mold or Brown Rot (Sclerotinia fructigena (Pers.) Schroet.).

This fungus is responsible for the brown rot of the peach and plum, and also occurs on apples, especially on those which are over-ripe, affected by frost, etc. The light-colored fruiting bodies of the fungus may be seen on the surface, and resemble a mold. This rot is of no economic importance in this State.

Fruit Mold (Penicillium sp.).

Some apple rots are associated with our common green mold, *Penicillium,* and other organisms, such as yeast, are sometimes present, which give a characteristic ferment odor.

This organism, however, must be considered as being purely an accompaniment of apple rot and not a specific cause of the trouble.

Core Rot.

Apples are sometimes found affected with what is termed core rot, an internal rot confined to the core. This disease has been observed in New York by Stewart, who describes the injured tissue as brown, dry and tasteless. No organism has been found associated with this trouble. Occasionally where worm holes occur there is more or less interior rotting of the fruit, but in the case of core rot there is no evidence of any communication between the exterior and interior of the fruit from the work of insects, etc. Only a few cases of this have been observed about here.

CANKERS.

There are a few fungi which cause a more or less common trouble to apple trees, termed cankers. Some of them are caused by organisms which affect apple trees in other ways; for example, *Sphæropsis* is caused by an apple rot as well as canker. The fire-blight organism produces canker, and in some sections a canker is produced by a bitter rot fungus (*Glomorella*). All of these cankers are more common on neglected trees.

Canker (*Sphæropsis Malorum Pk.*).

This fungus (Figs. 2 and 3) is associated with one of our common cankers, and is most frequently found on the smaller branches. It is characterized by dead areas on the bark, causing more or less irregular scars. On rapidly growing trees this canker sometimes causes a restricted growth and bending of the branches. Some phases of the canker resemble sun scald, and from our observations it appears to follow such injury. Treatment with lime and sulphur during the dormant period is undoubtedly as effective as any which can be recommended.

FIG. 2. — Showing *Sphæropsis* canker on apple twigs.

FIG. 3. — Showing irregular and twisted growth on apple branch due to canker (*Sphæropsis*).

European Apple Canker (*Nectria ditissima Tul.*).

This canker (Fig. 4) is usually characterized by ugly scars, due to the distortion of the tissue by the fungus named above. It is less common than the preceding canker, except on neglected trees, where it sometimes does much injury. Our earliest New England literature refers to canker on apple trees, and it is not unlikely that this is the one meant. In most cases it seems to follow injuries from various causes. Where the disease is severe it should be pruned out.

Nectria Canker (*Nectria cinnabarina* (*Tode*) *Fr.*).

This fungus (Fig. 5) is responsible for a canker which is characterized by the production of numerous cinnamon-colored pustules on the bark of dead wood. It is occasionally seen on apple trees, but more commonly on winterkilled branches of maples, horse chestnuts, etc. So far as our observations go, this is invariably a dead wood fungus following injuries of different types. The fungus penetrates the bark and wood and gives rise to discolored areas of the woody tissue.

Blight Canker.

A canker of rare occurrence with us has been described by Dr. H. H. Whetzel (Fig. 6). It is caused by the apple and pear blight organism, and occurs most frequently on young, smooth bark trees and on water sprouts. The diseased areas are smooth, sunken and brown in color, and there is no formation of pustules. The freshly affected tissues are usually watery, and in older cases cracking of the bark occurs. More often infection is confined to the bark, causing no injury to the wood. It is believed that only a small percentage of this canker lives through the winter to serve as a source of infection the following year, and that insects play some part in the work of infection. Another source of infection is the pruning knife.

Blister Canker (Nummularia discreta Tul.)

A form of canker caused by the above-named fungus has been observed in apple-growing regions of the Mississippi valley, but never in our section. This canker is characterized by a black, rough, more or less charred appearance of the bark on the older parts of the tree. On the surface of the diseased areas may be seen circular dots or fruiting bodies which are regarded as the most characteristic feature of the disease. We have recently seen a few apple trees in this section which seem to show the symptoms of this canker, but the specific fungus was not observed. It is believed to be a wound fungus.

Apple Rust (Gymnosporangium macropus Lk.).

This species of fungus is believed to be the principal cause of the apple rust in our section, one of the stages being found on the pear and quince. It is also believed to produce the so-called cedar apple on our common pasture juniper (*Juniperus virginiana*). Its appearance during the past few years has seemed to coincide with a general epidemic of rust throughout the country, and although it had been unusually rare on apples for many years in Massachusetts up to the past three or four years, since then it has often been found on foliage, and sometimes on the fruit. It is more common on neglected trees than in a scientifically managed orchard.

All rusts are difficult to control by spraying, but besides the general treatment which apple trees should receive each year, sanitary methods of culture should be practiced.

Apple Scab (Venturia Pomi (Fr.) Wint.).

A disease known as apple scab has been present in Massachusetts for many years, affecting both the leaves and fruit and occasionally the twigs of several varieties of apple trees, — in this State, more particularly the light-colored varieties. Fortunately, the disease seldom assumes a severe form here. It is more commonly found on the foliage than on the fruit, especially in unsprayed, neglected orchards. It is character-

FIG. 4. — Showing European canker (*Nectria ditissima*).

FIG. 5. — Showing canker (*Nectria cinnabarina*) on dead twigs.

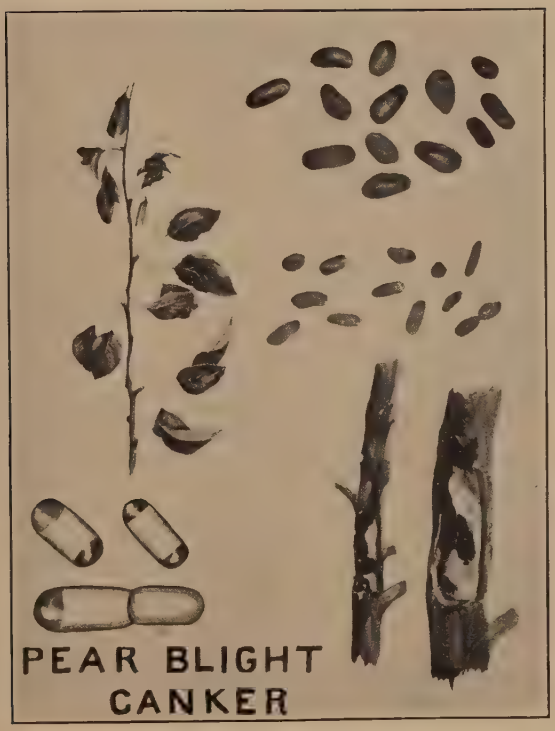

FIG. 6. — Pear blight canker.

ized on both the leaves and fruit by dark-colored or olivaceous spots, giving, as the name indicates, a scabby appearance to the fruit and leaves.

Treatment with lime and sulphur in the spring, in the dormant period, according to our observations, holds the fungus in check. Other fungicides also control it.

Pink Mold or Pink Rot (Cephalothecium roseum Cda.).

Since 1902 a pink mold has been known to be associated with apple scab, although it has caused little or no trouble in this region. As the name implies, it is of a pinkish color and is confined to the scabby spots on the fruit, developing over the surface of the scab. Although the fungus has been present for some time in this region on dead wood, etc., it was supposed to be perfectly harmless until 1902, when it was discovered as an accompaniment of the scab. It causes much more injury elsewhere than here, and is more severe in moist seasons.

Any treatment which will control the scab is applicable to this mold.

Leaf Blight (Sphæropsis Malorum Pk.).

It is generally believed at the present time, from the results of experiments, that the above-named fungus is the cause of the so-called leaf spots of the apple, although they were formerly attributed to other fungi, known as *Phyllosticta Pyrina* Sacc. and *P. limitata* Pk. These two species of *Phyllosticta* are now considered merely accompaniments of the leaf spot, occurring only in the later stages of the disease. The foliage of most neglected apple trees develops these spots, and the disease is sometimes severe enough to affect the growth of the tree. The fungi associated with the leaf spots, however, are easily controlled by spraying with lime and sulphur in the spring before the buds open, and therefore are of minor importance in well-cared-for orchards. Many orchards go through the season without a spot as a result of spraying with lime and sulphur in the dormant period of the tree.

Sooty Blotch or Fly Speck (Phyllachora pomigena (Schw.) Sacc.).

A fungous growth known as sooty blotch or fly speck has been common for many years, occurring on the surface of apples. With us it affects Greenings more commonly, sometimes discoloring the fruit to quite an extent. It was formerly believed that there were two species of fungi, — one causing the blotch, the other fly speck, — but it is now generally recognized that one species of fungus causes both. Both of these forms occur on the surface of the fruit and do not penetrate the cuticle, and they can easily be removed by washing.

Sooty blotch forms large, irregular, olive-brown areas on the fruit, while fly speck occurs as minute dark-colored dots scattered over the surface. The trouble appears to be more abundant in the shade and where there is considerable moisture. The fungus does not injure the fruit other than to affect its market value, and it can usually be controlled by spraying late in the season with Bordeaux mixture.

Apple Blight, Fire Blight, Twig Blight, etc. (Bacillus amylovorus (Burr.) DeToni.).

This blight has been common for many years on apples, pears and quinces, and is often severe in some parts of the United States. It is caused by a minute organism (bacillus), and it is generally recognized that infection takes place at the period of pollination. The blight is characterized by a blackening and shriveling of parts of the twigs or branches, and the leaves droop and turn brown, but do not fall. The organisms under certain conditions multiply very rapidly in the nectaries of the flower, and are readily transferred to other flowers by bees. From the nectaries the bacteria gain entrance to the tissues of the small branches, causing them to collapse. In most cases direct infection probably occurs by means of insects, abrasions, etc. The blight organism also occasionally causes what is termed blight canker. The

blight is not so serious in our section on the apple as on the pear and quince.

The principal methods of control consist in pruning out the infected limbs, at least a few inches below the affected region. Fall and winter pruning is considered better than summer pruning, since the affected parts may be more readily found, whereas in summer the disease may be spreading rapidly and all of it may not be eradicated. In all cases of pruning, antiseptic methods should be employed, such as sterilizing with formalin or some other substance the tools used in pruning, or treating the cut surfaces with creosote, etc.

Powdery Mildew (Erysiphe Polygoni DC.).

This mildew is seldom found on apples in this section. It occurs on nursery stock in some regions, where it causes more or less injury in the form of a mildew effect on the upper surface of the leaf.

Crown Gall.

Crown gall (Fig. 7) has caused vexation and worry to many fruit growers for the past few years, although the amount of actual injury done is somewhat problematical. For a few years considerable infected apple stock came into our State from outside, but for the past four or five years orchardists have been more particular about their material, and cleaner stock has been obtainable. There are only a few instances where trees have been so severely affected as to die, but one never knows when complications may set in and result in loss.

There are many forms of galls affecting plants, but practically all have a similar distorting effect on the tissue, which may seriously interfere with the vital processes of the plant. Eel worm galls, which are similar in appearance to those found on the apple tree roots, cause little injury to tomatoes and cucumbers, but are very injurious to roses, violets and melons, and in the south, various other crops, including some trees, are affected.

There is much difference of opinion as to the effect of crown

gall on apple trees, which appears to be more injurious in the warmer parts of the country. Nevertheless, no orchardist should accept material affected by this disease.

While the specific bacterial organism has been isolated, and many cross inoculations made, there is yet much to be learned concerning the relation of a particular type of gall to another. Extensive investigations made by Smith and Townsend seem to indicate that the organisms causing crown gall on the raspberry and apple are similar, yet our raspberry has had galls for years, while apple trees have been free from them until comparatively recently. Crown gall was not observed here until certain infected stock was obtained from outside the State. Where infected stock has been planted and cultivated, the disease spreads from one field to another, and seedlings raised on soil which was formerly free from the organism become infected. It is possible that much of our infected stock already planted will pull through and develop into bearing trees; but it is a wise precaution to secure clean trees when planting.

Crown gall, as its name implies, is characterized by a gall formation near the crown, which causes a distortion of the tissue, and in very severe cases it interferes with the function of the plant to such an extent that death results.

Hairy root (Fig. 8), which is characterized by the abnormal production of roots, giving a hairy effect, appears to be a similar trouble, although it is much less common with us.

Baldwin Spot or Fruit Pit.

This spot, which has been known by several names, has been present in Massachusetts since 1898 at least, and has been confined, to our knowledge, to the Baldwin in this section. It is characterized by small spots or indentations on the surface of the fruit, ranging from 2 to 4 millimeters or more in diameter, which are scarcely perceptible to one not acquainted with the disease. The spots are usually so insignificant that expert judges of fruit have been known to place premiums at fruit shows on apples badly affected with this trouble. In cutting open an affected fruit, numerous

FIG. 7. — Crown gall of apple.

FIG. 8. — Hairy root.

brown areas may be seen extending quite deeply into the tissue, which give it a bitter taste.

The cause of this spot is not known. Some years ago we tried to associate it with meteorological conditions, and interviewed many fruit growers in regard to its appearance in different seasons, but we were unable to establish any definite relationship, although the spot seemed to be more common after extremely dry periods. The disease is apparently of a functional nature, since spraying has no effect on it.

Baldwin Fruit Spot (Cylindrosporium Pomi Brooks).

This disease (Fig. 9) is characterized by spots very similar in many ways to those caused by the Baldwin spot or fruit pit, and has only been observed on apples in this State for three or four years. Only recently an experienced fruit grower, in describing this spot before a number of orchard specialists, found none of his audience familiar with it.

The spots are larger and more distinct, and the indentation is usually lacking, so that as a rule there is little excuse for confusing it with the old Baldwin spot. It attacks several varieties of apples, differing in this respect from the Baldwin spot previously noted. This disease is caused by a fungus (*Cylindrosporium Pomi* Brooks) and is much more severe here than the Baldwin spot, but like this it extends below the surface and turns the tissue a reddish brown. According to Dr. Brooks of the New Hampshire station, who has given it much attention, it first appears about the middle of August. The spots develop about two weeks before harvesting, during periods of dampness. The fungus gains entrance to the fruit in July or early August, and is said to be controlled by spraying with Bordeaux mixture, applications being made in June or early in July. From the general appearance of this spot one might surmise that it was the old Baldwin spot attacked by a fungus which has modified its appearance somewhat, although it occurs, as has been said, on a much larger number of varieties.

An inspection for the last three years of some of the best orchards in the State has revealed only a few affected apples

on each tree, although on individual trees in some orchards we have seen 50 per cent. of the apples diseased, and in many cases no spotting at all was seen. The trees which were so badly affected were old ones which had recently been cultivated and fertilized, and the manager attributed the outbreak to the application of nitrogenous fertilizers and the recent renovation of the orchard. Another successful orchard manager gave damp periods following drought as the cause. For five years we have been having severe droughts in the summer, followed by rains in the fall, and this spot has made its appearance during this period.

Winterkilling.

Winterkilling often occurs below the surface of the ground as well as above. During the cold winter of 1903–04 many apple trees were seriously injured, both above and below, in some States whole orchards being wiped out. Such injury is not always associated with cold weather, much depending on the condition of the tissue before the tree enters the winter.

The causes underlying winter injury are severe cold, when the frost penetrates to great depths; sudden and severe cold following prolonged warm periods in the fall; general low vitality, caused by lack of food; insect or fungous attacks; lack of moisture and organic matter in the soil; lack of snow covering; location in exposed situations, etc. Any condition which favors a soft growth and immaturity of the wood, whether from too much moisture or too heavy manuring and fertilizing, tends to produce winterkilling, as does also absence of sufficient sunlight. Trees growing where they receive the overflow from cesspools, etc., have been known to winterkill when others near by would not. Piling dirt three or four inches high around the base of young trees in winter often causes injury similar to winterkilling in nature, and tarred paper has the same effect.

Barnyard manure used as a mulching helps to prevent injury from winterkilling, and even sod is a great protection.

FIG. 9.—Showing Baldwin fruit spot (*Cylindrosporium*) on apple.

Frost Cracks.

Frost cracks are sometimes found disfiguring and injuring fruit trees by splitting the bark and wood of the limbs. In some cases they open only one-half inch or so, while in severe cases they may be three or four inches wide. They occur usually during sudden reductions in winter temperature. Extreme cold has a similar effect on the tissue to drying or shrinking, by causing a withdrawal of water from the cell walls, thus rupturing the tissue, and while the cracks sometimes heal over, they more often do not. They open wide in winter, and their opening and closing are affected by various meteorological conditions.

Frost cracks are very difficult to treat, but we have found that the best way to handle them is to paint the inner surfaces of the cracks with coal tar or paint in winter when they open up. Then in spring or summer, when the cracks close, staples of one-half or five-eighth inch iron, with prongs three or four inches long and pointed ends, may be driven into the trees after boring a hole with an auger. The staples should be painted and the bark cut away underneath, so that they may be driven in flush with the wood, when they will heal over and disappear.

Frost Blisters.

Occasionally during the past ten years we have observed a spotting on apple leaves caused by injury from spring frosts, and during the summer of 1902 considerable defoliation resulted, as much as 30 per cent. of the leaves falling from certain trees in July and August. The trouble was in general confined to the sections where the spring frost was most severe.

This frost injury occurs just as the leaves are unfolding, the frost rupturing the tender epidermal cells on the under side of the leaves. As the leaves develop, conspicuous, irregular spots may be found on the upper surface, corresponding in a general way to the ruptured areas on the under

side of the leaves. The heavy loss of water from the leaves following this injury causes them to deteriorate and fall off in large quantities.

Treating Cavities.

No tree is so often found with cavities as the apple, and perhaps none will thrive with so much decay of the heartwood, etc., as this species. The principal cause of the decay is poor pruning and lack of antiseptic treatment of wounds. When long stubs are left after pruning, the decay works into the heartwood and a cavity results. These long stubs never heal over, since the healing surface is not in direct communication with the flow of plastic substances. Large wounds, if not painted, will decay even if the branches are cut close.

Apple trees will live and thrive for many years, even when the heartwood of the trunk is completely destroyed, since the sapwood appears to be immune to most of the organisms causing decay. Modern tree surgery methods, however, can be used to good advantage on apple trees. A cavity should first have a thorough cleaning, followed by treatment with creosote, and should then either be filled with cement, or the orifice of the cavity tinned over or covered with some other suitable material.

Effects of Drought.

It often happens that in a wet spring trees will produce more foliage than they can support throughout the summer, especially if a severe drought occurs, resulting in a premature loss of foliage. The ideal moisture conditions for fruit trees consist in having a plentiful supply of moisture during the growth and early ripening of the fruit, with a bright and relatively dry period, characteristic of Indian summer, for the maturity. If there is too little moisture in summer the fruit is likely to be small; on the other hand, a dry summer followed by heavy fall rains affects the quality of the fruit and the ripening of the tissue, and is conducive to winterkilling. As already noted, it may also have some effect on the occurrence of the Baldwin spot.

Sun Scald.

This is a common type of injury, especially to the apple, pear, peach and plum, and is more likely to affect nonripened wood. It is much more common on neglected apple trees, and a few years ago was quite prevalent in the State, particularly on the lower branches, which were secluded from the light. Sun scald is characterized by a sunken, blackened appearance of the bark. Anything which prevents the wood from ripening makes the tree more susceptible to this trouble, and canker often follows it.

A similar trouble is known as collar rot, to which certain varieties of apples are particularly susceptible. This attacks the base of the tree, and is characterized by the death and abnormal appearance of the outer bark.

Storage Burns.

A storage burn of the apple which causes discolored spots, and which is undoubtedly a climatic trouble, occurs occasionally. This was unusually common during the fall of 1912, and one large shipment of Massachusetts apples to Europe was ruined in transit by the burn.

There are undoubtedly a number of causes responsible for storage burns, such as lack of light, too much soil moisture, etc., when the fruit is ripening, also warm periods such as were common during the past fall and winter (1912–13).

Spraying Injury.

Most of the spray injuries in our region result from unfavorable climatic conditions preceding or during the time of spraying, although some are due to the unusual susceptibility of certain varieties, and others to improperly prepared spray material. Peach and plum trees, for example, are injured by customary strengths of the Bordeaux mixture, and we have seen plum trees defoliated by spraying with arsenate of lead. It is possible to cause injury with almost any insecticide or fungicide under certain conditions,

and this is also true of fumigation. Many of our oil sprays have been known to injure apple and even shade trees when in the dormant condition, and judgment must be used in applying them. Even kerosene can sometimes be sprayed on certain plants without injury, although at other times it may kill the plant. Kerosene used directly or diluted with water is dangerous to many trees, as are various other oils.

Bordeaux mixture, even when properly prepared, causes burning to fruit trees under certain conditions (Fig. 10). In the south such injuries are more common than with us, but even here russeting of the fruit sometimes occurs from Bordeaux, as well as burning of the foliage. Meteorological conditions are responsible for some of the injury from spraying; for instance, spraying during cloudy periods, when the foliage and wood are not properly matured; and spraying mixtures left on the foliage in solution for a long or short period cause injury. Therefore, trees sprayed in the sunshine, when the solution quickly dries on the foliage, are less likely to burn. There are also many other factors which enter into burning of the foliage and russeting of the fruit, such as soil moisture.

Sunlight as a Factor in Apple Orchards.

No factor has a more important bearing on vegetation than sunlight. Through its action on foliage, plants obtain most of their food from the air, and tissue is rendered less susceptible to disease, since the physiological effect is to inhibit growth and render tissue more resistant. Aside from the necessity of pruning apple trees to make them low headed to facilitate picking the fruit, pruning is very important from the disease standpoint. Proper pruning and thinning give light a chance to reach all the branches, fruit and foliage, and thus modify the tissue and make it more resistant. Light is also important in preventing sun scald, winterkilling and other troubles.

A few years ago sun scald was quite common on neglected apple trees in our State. The most notable feature connected with the injury was the fact that it was confined to the shaded

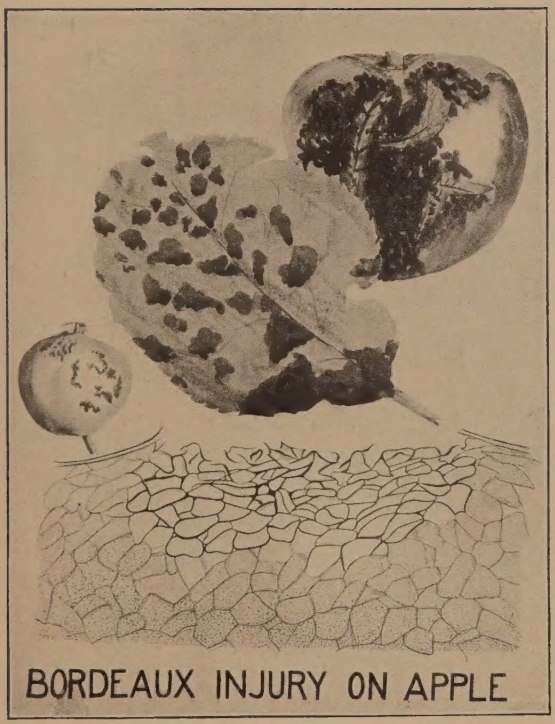

FIG. 10. — Bordeaux injury on apple.

limbs and branches where the light was more or less excluded, and was very rare on thinned trees. On the other hand, too intense light may cause injury to tender growths when shaded, as when young trees are suddenly stripped of their foliage by insects, or where too rapid growth results from severe pruning, followed by cultivation and fertilization. Sun scald is occasionally found on the larger limbs of trees which have been more or less shaded, and therefore receive too much light from severe pruning. A well-thinned tree is likely to be less affected by different diseases, and the danger from burning of various kinds is lessened.

Undoubtedly much of the spraying injury to fruit and foliage is associated with lack of light and other climatic factors, and the injury from fumigation has a relation to light intensity and moisture. There is much evidence to show that the practice of pruning apple trees is of much importance in controlling certain troubles.